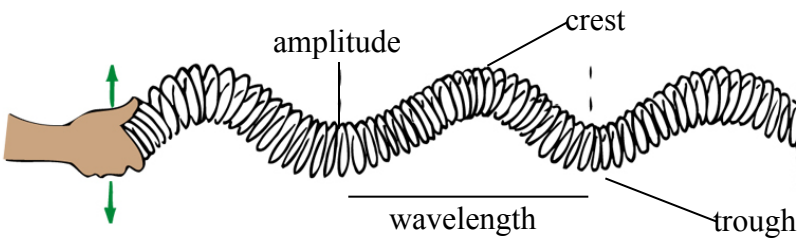
**Name** _____ **Date:**_____

**Waves**

When oscillators, be they pendulums, masses vibrating on springs, or electrons in an atom, are linked together, the motion of one affects the motions of the others. We say that the oscillators are *coupled*. When this is the case, we often see a repeated pattern that moves through the oscillators. We call this pattern a *wave*. Waves permit us to transmit oscillations over large distances and obtain information about objects that we cannot reach otherwise.

Transverse Waves

The picture below shows some *transverse* waves on a slinky and some of the terms we use to describe them.




The waves are initiated by the hand shown and travel to the right. You can use a slinky to see these waves in action.

Shown below are some additional terms we use to describe transverse waves.

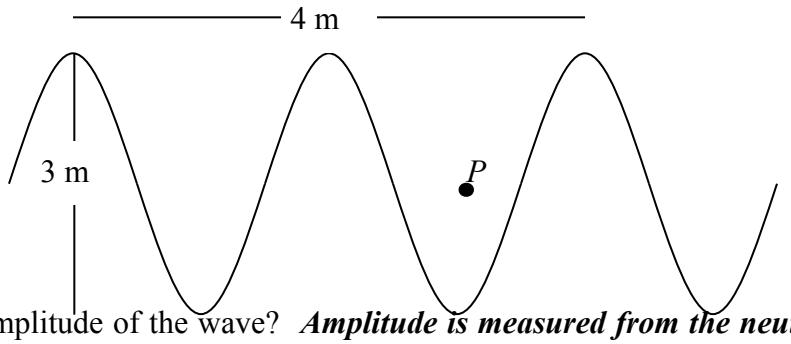
- frequency: the number of waves that pass by a point per unit of time
- period: the time it takes for one wave to pass by a point
- wave speed: how fast the wave moves, measured by a distance per unit of time.

1. Describe, in words, the following terms as they apply to transverse waves.
   (a) crest

   (b) trough

   (c) wavelength

2. Study the picture of the transverse wave below, traveling to the right. An observer notes that 5 waves pass by the point *P* in 10 s.




***(a)*** What is the amplitude of the wave? ***Amplitude is measured from the neutral axis or mid-point of the wave.***

***(b)*** What is the wavelength of the wave? ***Wavelength measures one wave from crest to crest***

***(c)*** What is the frequency of the wave? ***Frequency is the number of waves per second***

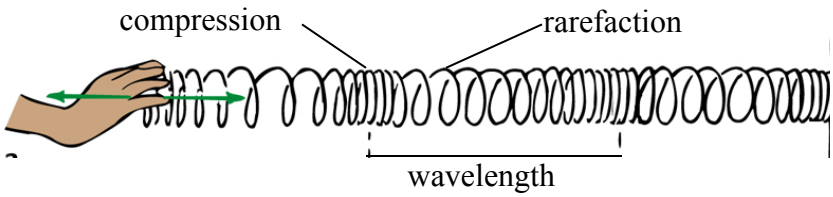
***(d)*** What is the period of the wave? ***The period is the time it takes for one complete wave***

(e) How far does the wave travel during the time you found in (d)?

***(f)*** What is the speed of the wave? ***Speed equals wavelength time frequency***

Longitudinal Waves

The picture below shows some *longitudinal* waves on a slinky and some of the terms we use to describe them.




The waves are initiated by the hand shown and travel to the right. You can use a slinky to see these waves in action. Most of the terms we use to describe transverse waves, such as frequency, period, and amplitude, apply to longitudinal waves as well.

3. Describe, in words, the following terms as they apply to longitudinal waves.
   (a) compressions

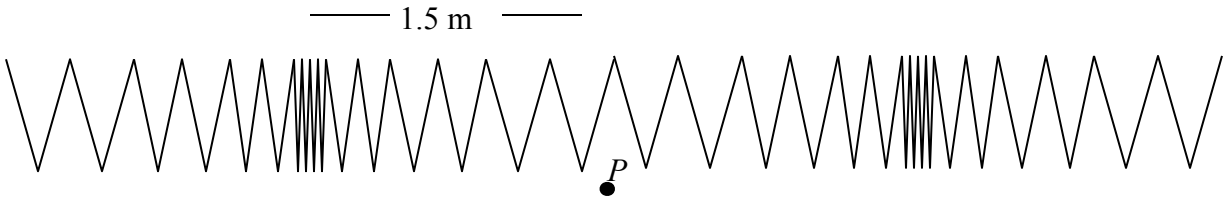
   (b) rarefactions

   (c) wavelength

4. Compare and contrast transverse and longitudinal waves.
   (a) What do they have in common?

   (b) What is different about them?

5. Study the picture of the longitudinal wave below. As it is travels to the right, an observer notes that it takes 0.4 s for one wave to pass by point *P*.




   (a) What is the wavelength of the wave?

***(b)*** What is the frequency of the wave? ***Frequency equals the inverse of Period (1/P)***

***(c)*** What is the period of the wave? ***Period is the time it takes for one wave to pass a point.***

(d) How far does the wave travel during one period?

***(e)*** What is the speed of the wave? ***Velocity equals frequency times wavelength***

Problem Solving

6. On the shores of Lake Maxinkuckee, 12 waves roll in to shore in 20 seconds. The distance between successive wave crests is 2 m.
   (a) In the space below, draw a picture of the waves and label the crests, troughs, and wavelength.

   (b) Is this a transverse or longitudinal wave?

   (c) What is the wavelength of the waves?

   (d) What is the frequency of the waves?

   (e) What is the period of the waves?

   (f) How far do the waves travel in 20 s?

   (g) What is the speed of the waves?

(h) How far do the waves travel in:

i. one minute?

ii. two minutes?

iii. five minutes?